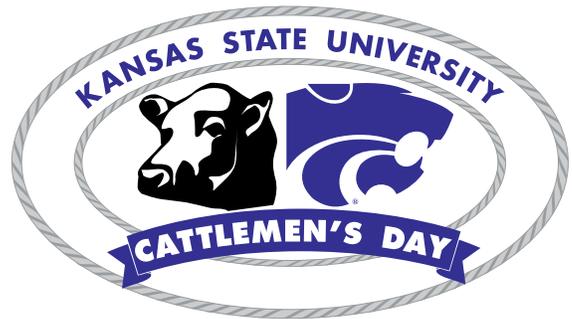


# BEEF RESEARCH HIGHLIGHTS 2009

SUMMARY PUBLICATION



KANSAS STATE UNIVERSITY  
AGRICULTURAL EXPERIMENT  
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# BEEF RESEARCH HIGHLIGHTS 2009

## Length of the Weaning Period Affects Postweaning Growth, Health, and Carcass Merit of Ranch-Direct Beef Calves Weaned During the Fall

*Justin Bolte*

**Objective:** Test validity of beef industry assumptions about the appropriate length of ranch-of-origin weaning periods for fall-weaned calves aged 160 to 220 days.

**Study Description:** Angus crossbred calves (n = 433) were stratified by age and assigned randomly to one of five weaning periods that corresponded to the length of time between separation from dam and shipping to market: 60, 45, 30, 15, or 0 days. Calves were vaccinated against common diseases 14 days before and again on the day of maternal separation. On a common shipping date (day 0; November 7), calves were transported 3 hours to a commercial auction market and held for 14 hours. Calves were then transported for less than 1 hour directly to a feedlot. All calves were fed the same diet ad libitum; they were also monitored 2 times daily for symptoms of respiratory disease. Carcass data, liver scores, and lung scores were collected.



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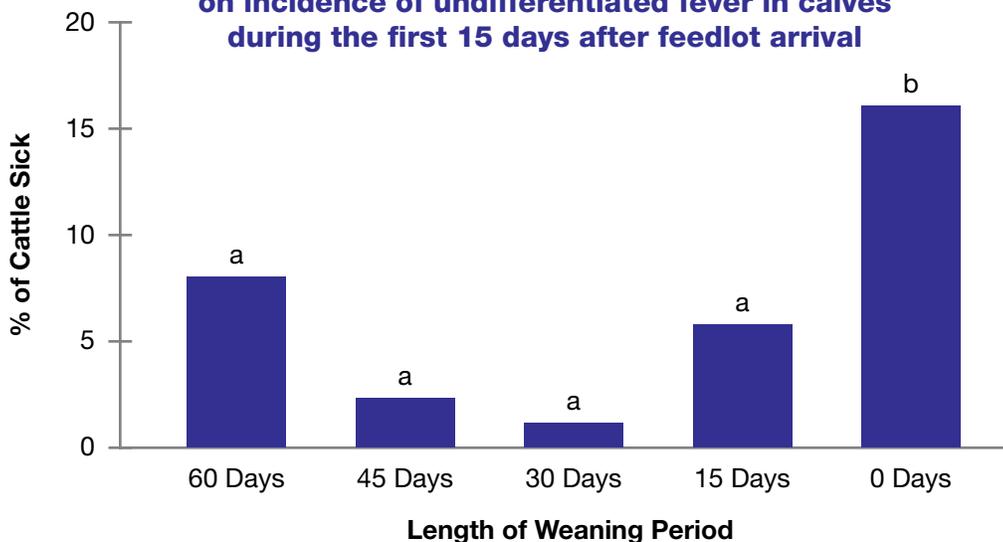
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**Effect of length of the ranch-of-origin weaning period on incidence of undifferentiated fever in calves during the first 15 days after feedlot arrival**



<sup>ab</sup> Means with unlike letters differ (P<0.01).

**The Bottom Line:** Under the conditions of our study, ranch-of-origin weaning periods between 15 and 60 days improved calf health during the receiving period compared with shipping calves immediately after maternal separation. Ranch-fresh calves that are properly vaccinated before maternal separation and exposure to market conditions may not require ranch-of-origin weaning periods longer than 2 weeks to achieve optimal health during the receiving period.

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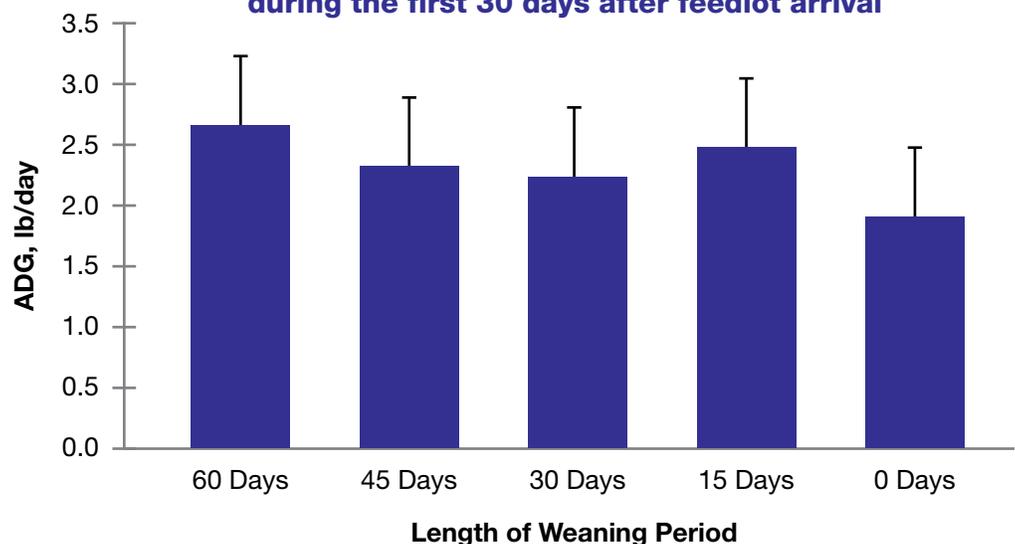
## Length of the Ranch-of-Origin Weaning Period Does Not Affect Post-Receiving Growth or Carcass Merit of Ranch-Direct, Early-Weaned Beef Calves

*Justin Bolte*

**Objective:** Test validity of beef industry assumptions about the appropriate length of ranch-of-origin weaning periods for summer-weaned calves aged 100 to 160 days.

**Study Description:** Angus crossbred calves (n = 400) were stratified by age and assigned randomly to one of five weaning periods that corresponded to the length of time between separation from dam and shipping to market: 60, 45, 30, 15, or 0 days. Calves were vaccinated against common diseases 14 days before and again on the day of maternal separation. On a common shipping date (day 0; August 24), calves were transported 3 hours to a commercial auction market and held for 14 hours. Calves were then transported for less than 1 hour to a feedlot. All calves were fed the same diet ad libitum throughout the trial. Upon slaughter, livers and lungs were evaluated and carcass measurements were collected.

**Effect of length of the ranch-of-origin weaning period on average daily gain (ADG) of lightweight calves during the first 30 days after feedlot arrival**



Treatment means are similar (P=0.3).

**The Bottom Line:** Under the conditions of our study, ranch-of-origin weaning periods between 15 and 60 days did not improve growth performance or carcass merit relative to shipping calves immediately after maternal separation.



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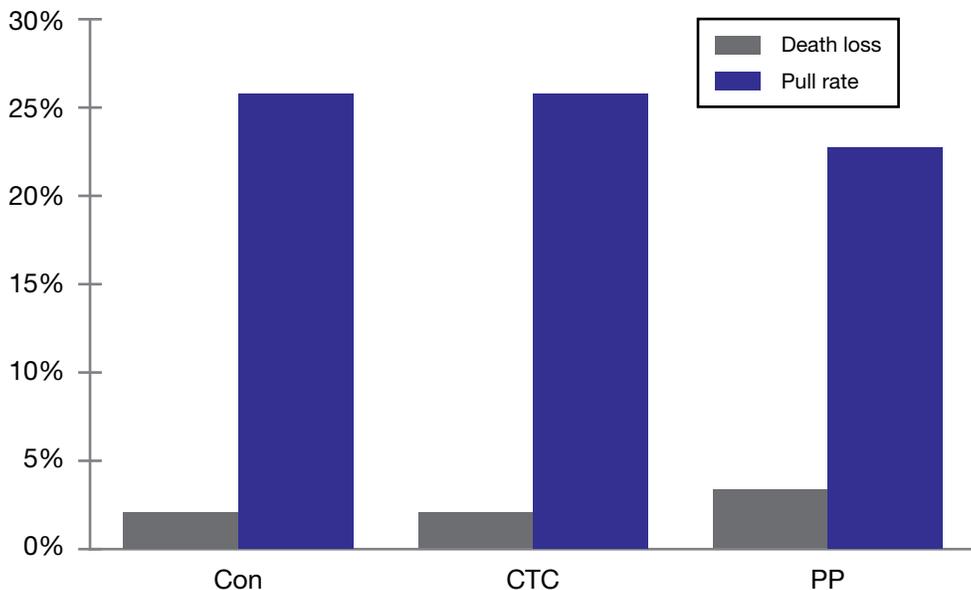
## Concurrent Metaphylaxis with Chlortetracycline and Tulathromycin on High-Risk Calves Has No Additive Effects on Cattle Health and Performance

*Justin Wallace*

**Objective:** Examine effects of concurrent metaphylaxis with tulathromycin (Draxxin) and chlortetracycline (Aureomycin) upon arrival on high-risk stocker calf health and performance.

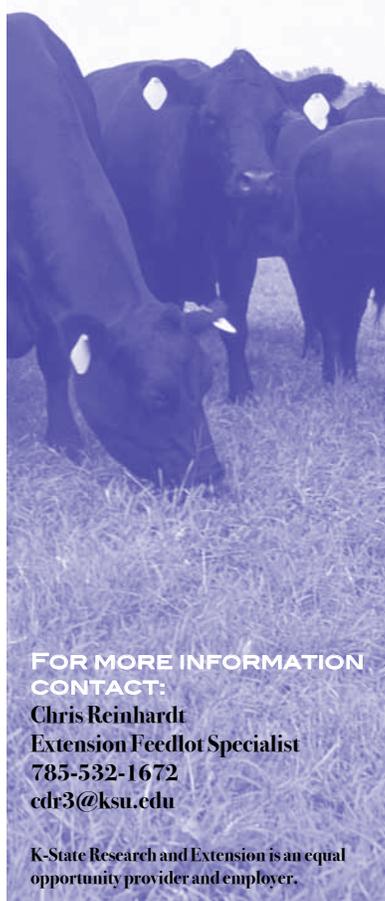
**Study Description:** High-risk stocker calves were delivered to the Kansas State University Beef Stocker Unit in November 2007 and March 2008 (n = 463, initial body weight = 447 lb). All calves received Draxxin upon arrival. Treatments consisted of no pellets, pellets containing chlortetracycline, or pellets containing no chlortetracycline. There were no effects of treatment on performance or incidence of clinical disease.

**Effects of addition of either a pellet treated with Aureomycin (CTC) or a plain, unmedicated pellet (PP) compared with no pellet (CON)**



There were no differences in pull rate or death loss between treatments.

**The Bottom Line:** This experiment showed no additive effects of metaphylaxis by using Draxxin concurrently with Aureomycin.



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# BEEF RESEARCH HIGHLIGHTS 2009

## Dried Corn Germ in Natural Finishing Programs Reduces Incidence of Liver Abscess

*Justin Wallace*



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**Objective:** Objectives of this experiment were to assess the effect of supplemental fat in the form of dried, full-fat corn germ (GERM) on growth performance, carcass yield and quality grades, and incidence of liver abscesses when fed to finishing cattle as part of a “natural” feeding regimen applied under commercial feeding conditions.

**Study Description:** Yearling steers and heifers (n = 4,199; initial body weight = 703 lb) were used to characterize feedlot performance, health, incidence of liver abscess, and carcass traits of feedlot cattle produced under a natural feeding regimen with and without GERM added to the finishing diet. Cattle were housed at a commercial feedlot in central Kansas. Diets contained either 0 or 5% GERM. Addition of GERM increased carcass-adjusted average daily gain and reduced severe liver abscesses.

### Liver abscesses in cattle fed 0 or 5% full-fat corn germ during the finishing period

Item, %	Treatment		SEM	P-value
	Control	5% Germ		
Total liver abscesses	67.9	55.9	2.97	0.01
Mild abscesses <sup>1</sup>	27.3	27.2	1.34	0.97
Moderate abscesses <sup>2</sup>	18.6	14.9	1.58	0.11
Severe abscesses <sup>3</sup>	21.9	13.7	2.38	0.02

<sup>1</sup> Mild = livers with one or two small abscesses.

<sup>2</sup> Moderate = livers with two to four well organized abscesses less than 1 in. in diameter.

<sup>3</sup> Severe = livers with one or more large abscesses.

**The Bottom Line:** Adding GERM to the diet may help control incidence of liver abscess in naturally raised cattle, a problem incurred by many producers who raise beef naturally, without use of tylosin.



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## Backgrounding Health Associated with Area of the Truck Where Cattle Were Housed During Transport

*Brad J. White*

**Objective:** Determine potential differences in backgrounding health associated with cattle location within a commercial transport vehicle.

**Study Description:** Data were collected in conjunction with normal operations of the Kansas State University Beef Stocker Unit. Southeastern origin cattle were commingled in Tennessee and shipped to Manhattan, KS. Upon arrival, cattle from each load were unloaded by section of the transport carrier and placed in holding pens, maintaining segregation of animals by original truck compartment. Cattle were weighed and individually identified by holding pen, and the section of the transport vehicle was recorded for each animal. Cattle were backgrounded for 45 to 60 days, and all illness was recorded. An analysis was performed to determine the association between animal location on the truck and subsequent health outcomes.

**Results:** No significant associations were identified between compartment of the transport vehicle or placement on the top or bottom deck and the probability of initial treatment or dying. However, cattle in the middle section had a higher probability of being treated at least once compared with cattle in the most forward sections. Calves in the rear compartments had lower ADG from arrival to reweigh compared with cattle in the middle or forward areas.

**The Bottom Line:** This research illustrates some associations between backgrounding health and cattle location within a commercial transport vehicle. Our current project reveals that the environment within a commercial transport carrier varies by compartment, and further research should be done to determine causes for the health variation.



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## Estrous Synchronization of Beef Heifers Using 7-11 Synch or 7-11 Synch + CIDR

*Douglas Eborn*

**Objective:** Determine the effect of inserting an intravaginal progesterone-releasing device (CIDR) at the time of gonadotropin-releasing hormone (GnRH) in the 7-11 COSynch protocol on heat response, interval to estrus, and conception rates in beef heifers.

**Study Description:** Heifers were assigned to either 7-11 Synch or 7-11 Synch + CIDR treatments. All heifers were fed melengestrol acetate (MGA) for 7 days and given Prostagmate™ on the last day of MGA feeding. Four days later, heifers received an injection of OvaCyst™, and 7 days later heifers received a second injection of Prostagmate. Heifers assigned to the 7-11 Synch + CIDR treatment were given a CIDR between the OvaCyst injection and the second Prostagmate injection. Heifers were artificially inseminated 12 hours after onset of estrus.

**Results:** Overall heat response was 85% and not different between herds or treatments. Conception rates for 7-11 Synch (65%) and 7-11 Synch + CIDR (60%) were not different. The mean interval to estrus was 46 hours for 7-11 Synch and 49 hours for 7-11 Synch + CIDR.

**The Bottom Line:** Final pregnancy rates for 7-11 Synch and 7-11 Synch + CIDR are similar to those achieved in with 7-11 COSynch by using timed artificial insemination in past years in these same herds. Current data suggest that using a CIDR in the 7-11 Synch system may decrease the time needed for estrous detection.



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# BEEF RESEARCH HIGHLIGHTS 2009

## Combinations of Flaked Corn, Dry-Rolled Corn, and Distillers Grains Yield Beef with Similar Quality yet Subtle Changes in Sensory Traits

*Patricia Black*

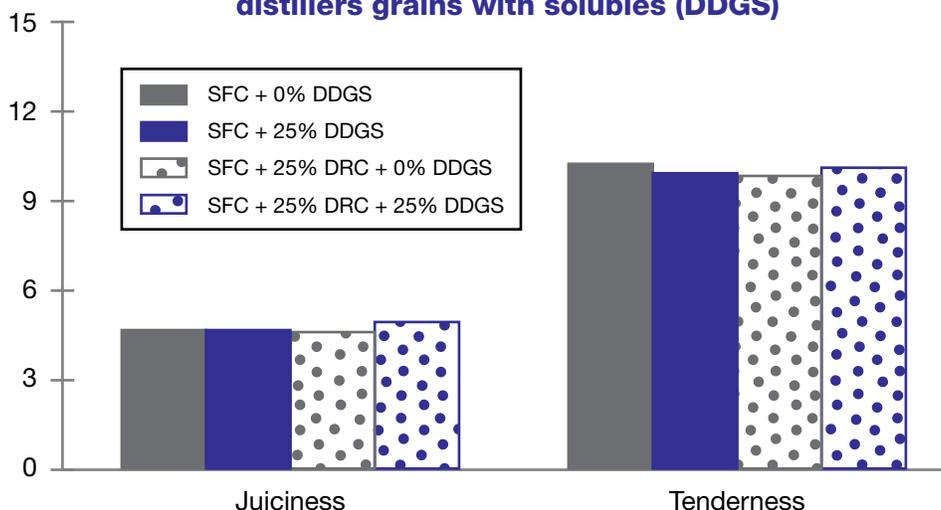
**Objective:** Determine the effects of replacing a portion of steam-flaked corn in the diet with dry-rolled corn or dried distillers grains on meat quality and composition.

**Study Description:** Crossbred yearling heifers (n = 689; 664 ± 143 lb) were fed flaked-corn finishing diets with 0 or 25% dried distillers grain and with 0 or 25% dry-rolled corn. Heifers were fed free choice once daily in 28 dirt-surfaced pens with 23 to 25 head per pen. Cattle were blocked by weight into light and heavy weight groups and fed for 157 or 137 days, respectively. Meat samples were collected, and meat quality was measured by evaluating meat color, lipid oxidation, sensory attributes, and vitamin E content.



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**Sensory attributes of ribeye steaks from cattle fed steam-flaked corn (SFC) diets containing 0 or 25% dry-rolled corn (DRC) and 0 or 25% dried distillers grains with solubles (DDGS)**



Sensory attributes evaluated on a subjective 15-point scale; 15 = most desirable.

**The Bottom Line:** Replacing a portion of steam-flaked corn with either dry-rolled corn or dried distillers grains would be expected to yield beef with similar meat quality and composition yet subtle changes in sensory traits compared with beef from animals fed traditional flaked-corn diets.



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# BEEF RESEARCH HIGHLIGHTS 2009



## Distillers Grains Do Not Change Carcass Composition but Change Some Fatty Acids When Added to Finishing Diets

*Patricia Black*

**Objective:** Determine the effects of replacing a portion of steam-flaked corn in the diet with dry-rolled corn or dried distillers grains on carcass composition, fatty acids, and heterocyclic amine formation.

**Study Description:** Crossbred yearling heifers (n = 689; 664 ± 143 lb) were fed steam-flaked corn finishing diets with 0 or 25% dried distillers grains and 0 or 25% dry-rolled corn. Cattle were blocked by weight into light and heavy weight groups and fed for 157 or 137 days, respectively. Meat samples were collected and evaluated for percentage lean, fat, and bone; fatty acid profiles; and amounts of heterocyclic amine released from cooked steaks.

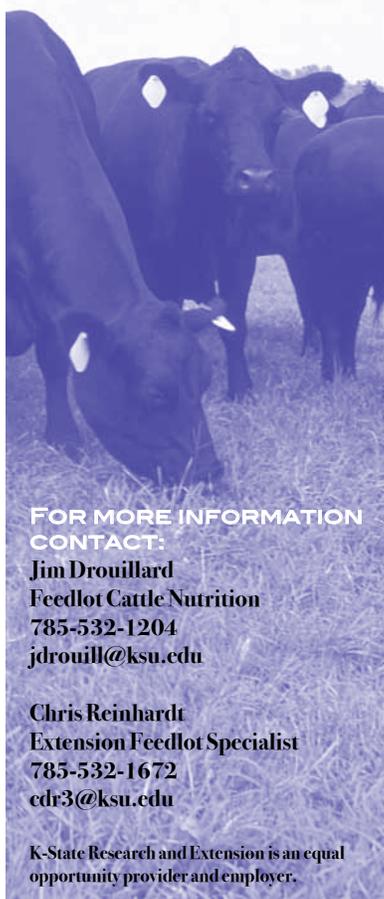
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### 9th-10th-11th rib separation values, actual and calculated, from cattle fed steam-flaked corn (SFC) diets containing 0 or 25% dry-rolled corn (DRC) and/or 0 or 25% dried distillers grains with solubles (DDGS)

Item	SFC		SFC + 25% DRC		SEM	P-values		
	0% DDGS	25% DDGS	0% DDGS	25% DDGS		DRC	DDGS	DRC*DDGS
Bone, % of dressed carcass	15.3	16.2	15.5	15.5	0.31	0.44	0.11	0.10
Lean, % of dressed carcass	56.1	54.0	55.4	55.6	0.84	0.56	0.23	0.18
Fat, % of dressed carcass	28.4	28.7	28.5	28.4	1.06	0.96	0.92	0.82

**The Bottom Line:** Replacing a portion of steam-flaked corn with either dry-rolled corn or dried distillers grains resulted in similar carcass composition.



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## Dry-Rolled Corn or Dried Distillers Grains Can Replace Portions of Steam-Flaked Corn

*Patricia Black*

**Objective:** Determine the effects of replacing portions of steam-flaked corn in finishing diets with dry-rolled corn or dried distillers grains.

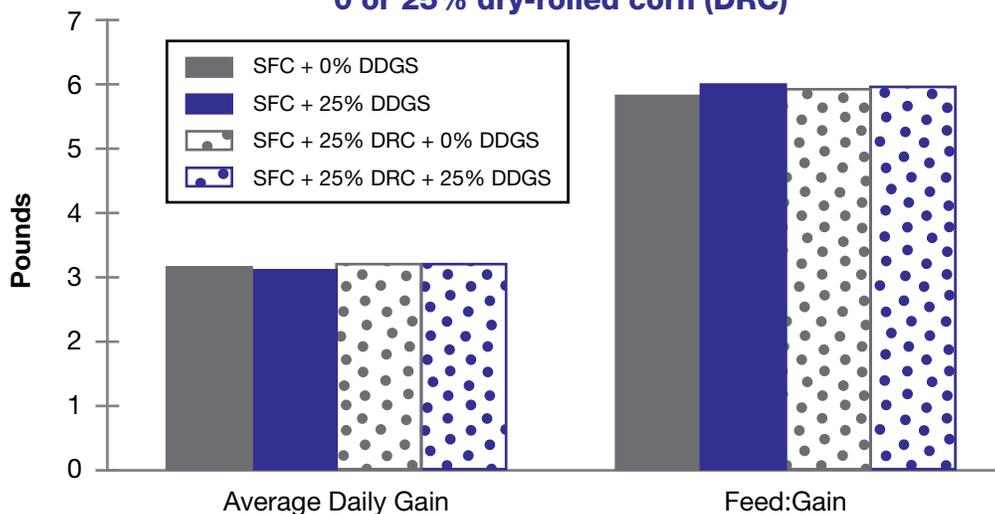
**Study Description:** Crossbred yearling heifers (n = 689; 664 ± 143 lb) were fed flaked-corn finishing diets with 0 or 25% dried distillers grains and 0 or 25% dry-rolled corn. Heifers were fed free choice once daily in 28 dirt-surfaced pens with 23 to 25 heifers per pen. Cattle were blocked by weight into light and heavy weight groups and fed for 157 or 137 days, respectively. Feedlot performance and carcass characteristics were measured.



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**Average daily gain and feed conversion for heifers fed steam-flaked corn (SFC) finishing diets with 0 or 25% dried distillers grains (DDGS) and 0 or 25% dry-rolled corn (DRC)**



**The Bottom Line:** Dried distillers grains or dry-rolled corn can replace a portion of steam-flaked corn without altering feedlot performance or carcass merit.



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## Feed Depredation by European Starlings

*Brandon Depenbusch*

**Objective:** Evaluate feed depredation by European starlings.

**Study Description:** Thirty individual feeding sites were constructed by dividing a concrete fence-line feed trough into 30-in. sections. Each feeding site received 30 lb of a different feedlot ration (i.e., four different meal-type rations and one extruded ration) prior to arrival of starlings. After starlings left the feedlot and returned to their evening roost, remaining feed was weighed and sampled. Samples of fresh and residual feed were then analyzed for crude protein, crude fat, starch, and crude fiber.

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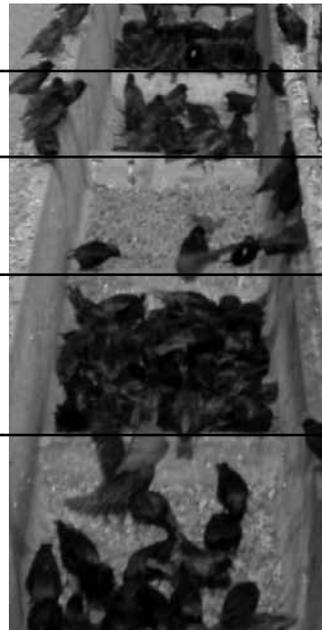
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### Selection Preferences of European Starlings

Diet	Nutrient Analyses, %			
	Starch		Fiber	
	Before	After	Before	After
Steam-flaked corn, alfalfa hay, and distiller's grains	61	22	22	36
Steam-flaked corn and alfalfa hay	69	30	15	37
Extruded corn and alfalfa hay	73	67	14	13
Dry-rolled corn and alfalfa hay	70	44	15	27
Steam-flaked corn and silage	67	28	19	41



**The Bottom Line:** Starlings preferentially select some feed ingredients, especially grains, thereby altering nutrient content of diets. Extruding the ration prevents feed depredation by starlings.

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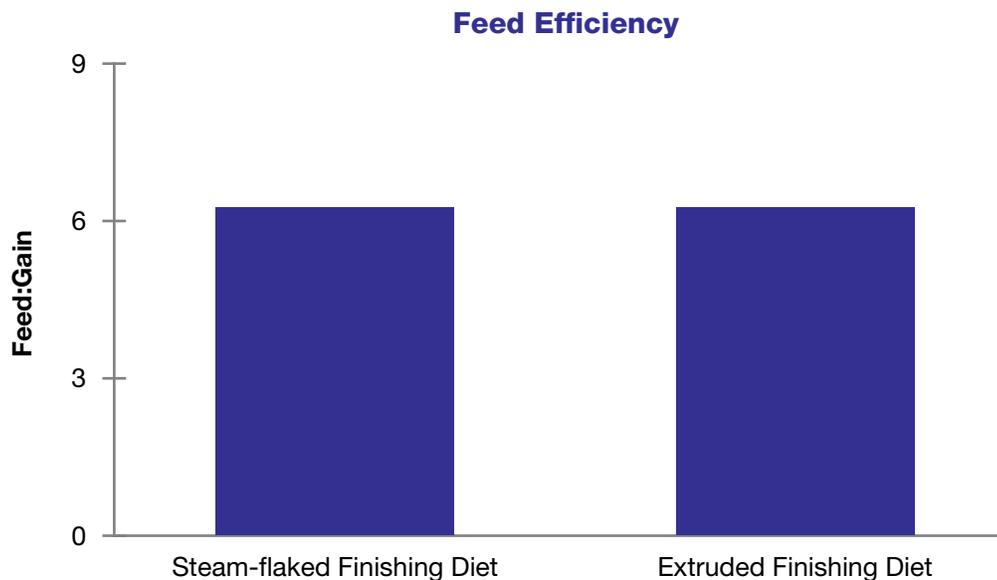
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## Extruded Complete Feed for Finishing Cattle

*Brandon Depenbusch*

**Objective:** Evaluate animal performance, carcass characteristics, and meat attributes of yearling heifers fed extruded finish diets.

**Study Description:** Seventy-two yearling heifers (796 lb initial body weight) were used in a 143-day finishing study. Treatments were designed to test differences in grain processing (steam flaked vs. extruded) and level of alfalfa hay (2 vs. 6%). Extruded diets were processed to different degrees (moderate vs. high) depending on retention time, temperature, and pressure settings of the extruder. Steaks from each heifer were collected and used to evaluate tenderness, cooking loss, and retail display color.



**The Bottom Line:** Compared with a flaked-corn diet, the complete extruded feed improved feed efficiency by 15% with no negative effects on carcass quality.

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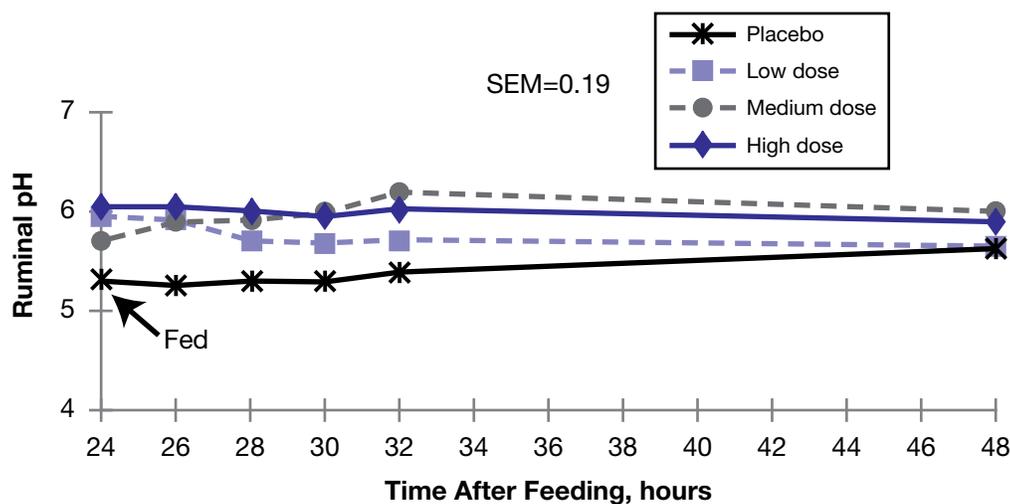
## Effects of *Megasphaera elsdenii* on Ruminant pH, Ruminant Concentrations of Organic Acids, and Bacterial Genomes Following a Grain Challenge

Reid McDaniel

**Objective:** Determine the efficacy of orally dosing cattle with *Megasphaera elsdenii* for preventing ruminal accumulation of lactic acid.

**Study Description:** Crossbred Angus steers (n = 20; average initial body weight = 558 lb) were used in a metabolism study to determine effects of ruminal inoculation with *M. elsdenii* on ruminal conditions and organic acid production following an abrupt diet change. Treatments consisted of a placebo or a low, medium, or high dose of a live culture containing *M. elsdenii* strain NCIMB 41125. Background samples were taken from animals on day 1 of the experiment to establish ruminal conditions prior to the diet change. On day 2, ruminal contents were collected from each animal and the appropriate inoculum was administered. Immediately following dosing and sampling, steers were given free-choice access to a flaked corn diet. Immediately following sampling, ruminal pH was measured and subsamples were taken for analysis of ruminal organic acids and concentrations of *M. elsdenii*.

**Ruminal pH Following Inoculation and Grain Challenge**



Ruminal pH remained higher 24 hours after feeding a grain-based diet in steers given a live dose than in steers given a placebo (P<0.05).

**The Bottom Line:** Dosing cattle with *M. elsdenii* before feeding a grain-based diet may help prevent accumulation of lactic acid and thus avoid severe depressions in ruminal pH that may cause ruminal acidosis.

# BEEF RESEARCH HIGHLIGHTS 2009

## Higher Ruminant pH Increases In Vitro Digestion of Diets Containing Distillers Grains

*Solange Uwituze*

**Objective:** Determine effects of pH on in vitro fermentative activity of ruminal contents from cattle adapted to a finishing diet containing 25% distillers grains (dry-matter basis).

**Study Description:** We conducted an in vitro study to investigate effects of three pH levels (5.0, 5.5, or 6.0) on fermentative activity of ruminal contents from cattle adapted to a finishing diet containing 25% (dry-matter basis) dried distillers grains with solubles at three incubation times (6, 12, and 24 hours). A 50:50 mixture of distillers grains and dry-rolled corn was fed to the test tube cultures. We attained our targeted pH levels by using citric acid or phosphoric acid. We measured concentrations of volatile fatty acids and disappearance of dry matter.



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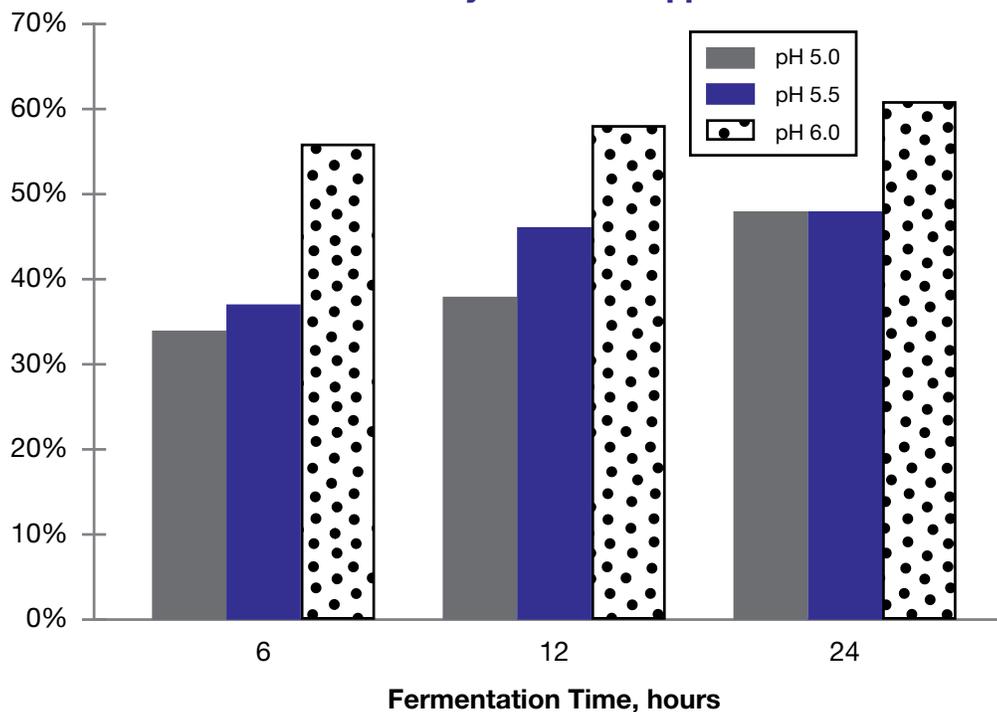
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**In Vitro Dry Matter Disappearance**



**The Bottom Line:** Feeding strategies aimed at increasing ruminal pH may be a logical approach for improving digestion of distillers grains in flaked-grain finishing diets.

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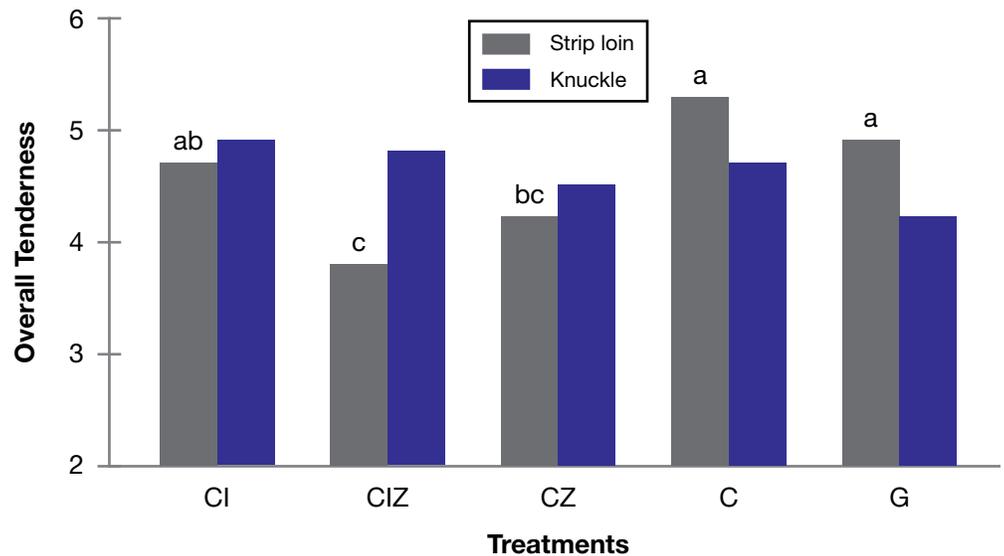
## Management Practices Affect Tenderness of Strip Loin but Not Knuckle Steaks from Fed Mature Cows

*Shanna Neill*

**Objective:** Determine effects of concentrate feeding, implanting with Revalor<sup>®</sup>-200, and feeding Zilmax<sup>®</sup> on tenderness of strip loin and knuckle steaks from mature cows fed for 70 days.

**Study Description:** Sixty cull cows were assigned to one of five treatments: (1) grass fed on pasture (G), (2) concentrate fed (C) a grain sorghum-sorghum silage diet, (3) concentrate fed and implanted (CI) with Revalor-200 (trenbolone acetate-estradiol), (4) concentrate fed and fed Zilmax (zilpaterol hydrochloride) for 30 days followed a 3-day withdrawal (CZ), and (5) concentrate-fed, implanted, and fed Zilmax (CIZ). Strip loin and knuckle subprimals were aged for 14 days and cut into steaks for sensory determination.

**Sensory Panel Tenderness**



<sup>abc</sup> Bars without a common letter for the strip loin differ ( $P < 0.05$ ).  
Scale: 8 = extremely tender, 1 = extremely tough.

**The Bottom Line:** Feeding Zilmax would be expected to decrease tenderness of strip loin but not knuckle steaks. Because all treatments resulted in steaks that were marginal in tenderness, postmortem tenderization protocols may be needed to assure acceptable tenderness.

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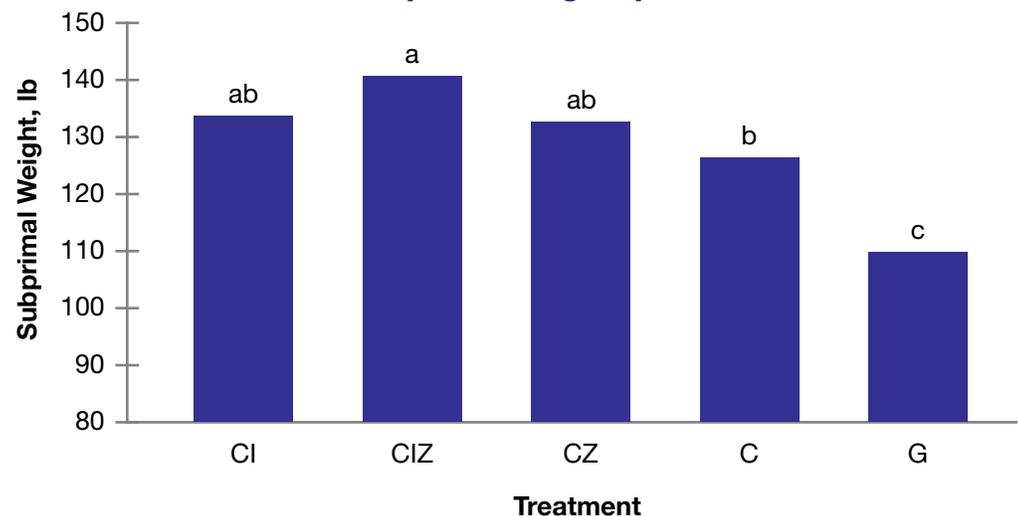
## The Combination of Implanting with Revalor-200 and Feeding Zilmax Increases Subprimal Meat Yield of Fed Cows

*Shanna Neill*

**Objective:** Determine effects of concentrate feeding, implanting with Revalor<sup>®</sup>-200, and feeding Zilmax<sup>®</sup> on subprimal meat yield of cull cows fed for 70 days.

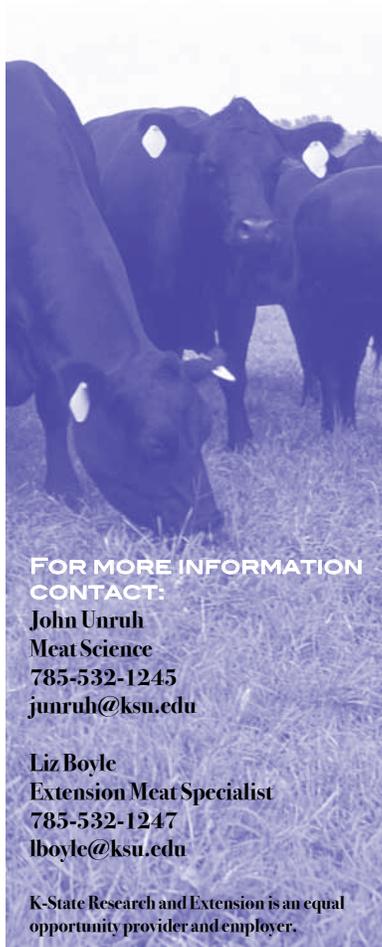
**Study Description:** Sixty cull cows were assigned to one of five treatments: (1) grass fed on pasture (G), (2) concentrate fed (C) a grain sorghum-sorghum silage diet, (3) concentrate fed and implanted (CI) with Revalor-200 (trenbolone acetate-estradiol), (4) concentrate fed and fed Zilmax (zilpaterol hydrochloride) for 30 days followed a 3-day withdrawal (CZ), and (5) concentrate fed, implanted, and fed Zilmax (CIZ). Cattle were fed for 70 days, and subprimals were removed and weighed approximately 72 hours postmortem.

**Total Subprimal Weights per Carcass Side**



<sup>abc</sup> Bars without a common letter differ ( $P < 0.05$ ).

**The Bottom Line:** Concentrate feeding can increase subprimal meat yield, and the combination of implanting and feeding Zilmax to cows can further increase subprimal meat yield.



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## The Combination of Implanting with Revalor-200 and Feeding Zilmax Increases Ribeye Area of Fed Cows

Shanna Neill

**Objective:** Determine effects of concentrate feeding, implanting with Revalor<sup>®</sup>-200, and feeding Zilmax<sup>®</sup> on performance and carcass characteristics of cull cows fed for 70 days.

**Study Description:** Sixty cull cows were assigned to one of five treatments: (1) grass fed on pasture (G), (2) concentrate fed (C) a grain sorghum-sorghum silage diet, (3) concentrate fed and implanted (CI) with Revalor-200 (trenbolone acetate-estradiol), (4) concentrate fed and fed Zilmax (zilpaterol hydrochloride) for 30 days followed a 3-day withdrawal (CZ), and (5) concentrate fed, implanted, and fed Zilmax (CIZ). Cattle were fed for 70 days before slaughter and carcass data collection.



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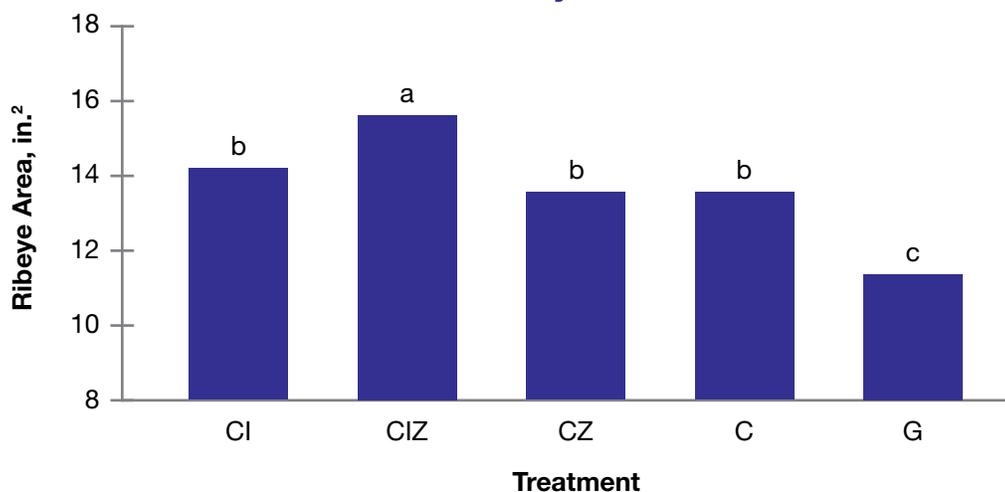
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**Ribeye Area**



abc Bars without a common letter differ ( $P < 0.05$ ).

**The Bottom Line:** Concentrate feeding can increase hot carcass weight, dressing percentage, and ribeye area of cull cows, and the combination of implanting Revalor-200 and feeding Zilmax to cows can further increase ribeye area.

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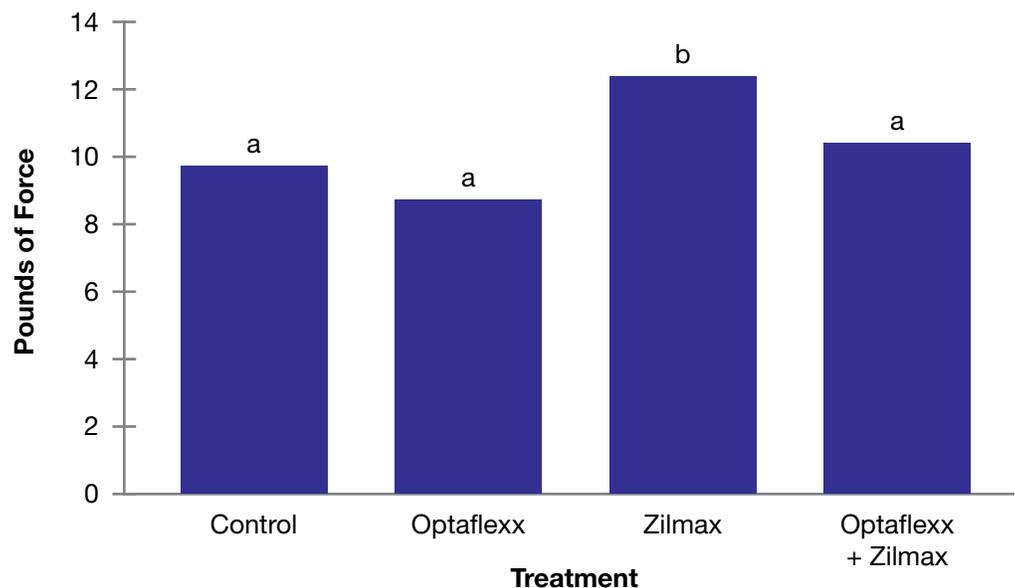
## Using Sequential Feeding of Optaflexx and Zilmax to Improve Performance and Meat Quality in Cull Cows

*Melissa Daniel*

**Objective:** Determine effects of implanting and feeding a concentrate ration plus supplementation with Optaflexx<sup>®</sup> and Zilmax<sup>®</sup> or a sequence of Optaflexx followed by Zilmax on cow performance, carcass characteristics, and meat tenderness.

**Study Description:** Sixty cull cows were assigned to one of four treatments: (1) Control = concentrate fed for 82 days, (2) Optaflexx = concentrate fed for 57 days and supplemented with Optaflexx for 25 days, (3) Zilmax = concentrate fed for 59 days and supplemented with Zilmax for 20 days with a 3-day withdrawal, and (4) Optaflexx + Zilmax = concentrate fed 34 days and supplemented with Optaflexx for 25 days followed by Zilmax for 20 days with a 3-day withdrawal. Cattle were harvested, carcass data were collected, and muscle tenderness was evaluated.

### Longissimus Warner-Bratzler Shear Force



<sup>ab</sup> Bars with a different letter differ ( $P < 0.05$ ).

**The Bottom Line:** Feeding a sequence of Optaflexx followed by Zilmax can improve tenderness compared with feeding Zilmax alone and could increase marbling and lean color scores.

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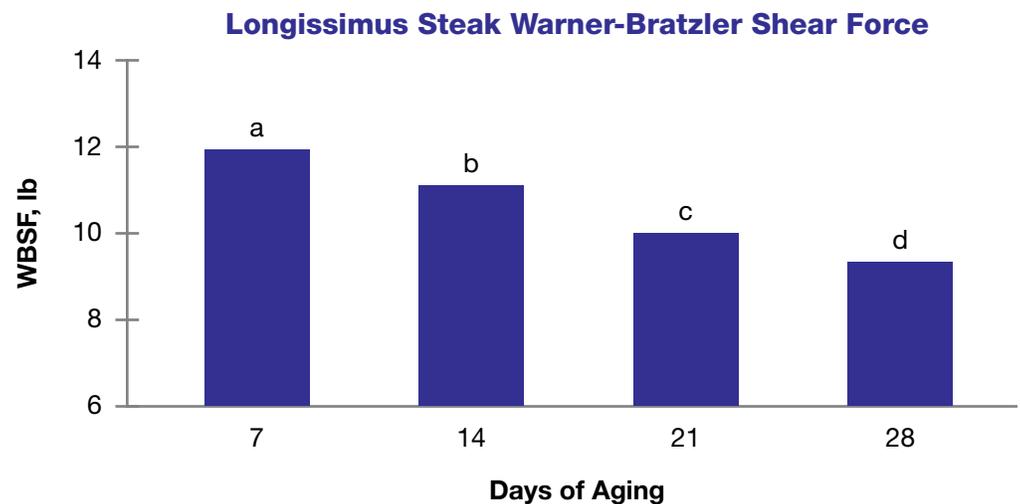
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## Aging Improves Tenderness of Longissimus Muscle Steaks from Fed Mature Cows

*Amanda Gipe*

**Objective:** Determine effects of aging on tenderness of longissimus muscle from cull cows.

**Study Description:** Longissimus muscle steaks from 53 cull cows were used in this study. Cows were from a study investigating effects of different management practices on performance and carcass characteristics. One-inch longissimus muscle steaks from each cow were cut and aged in vacuum packaging for 7, 14, 21, or 28 days at approximately 32° F. Steaks were cooked on the final day of aging, and Warner-Bratzler shear force values were determined the following day.



<sup>abcd</sup> Bars without a common letter differ ( $P < 0.05$ ).

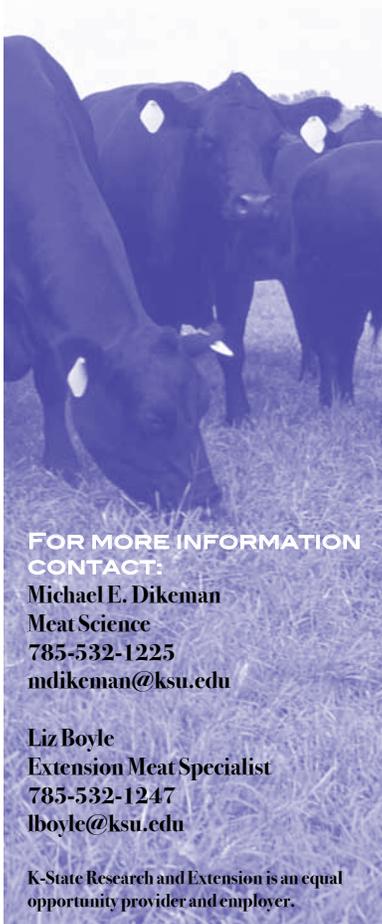
**The Bottom Line:** Tenderness of longissimus muscle steaks from fed mature cows improves as days of postmortem aging increase.

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## Needle-Free Injection Enhancement of Beef Improves Tenderness but Slightly Increases Microbial Translocation

*Ashley Sutterfield*

**Objective:** Compare effects of needle-free injection and traditional needle injection on microbial translocation of generic *Escherichia coli* into subsurfaces of beef strip loins and determine effects on tenderness and color.

**Study Description:** Five longissimus muscles from USDA Select carcasses were used in preliminary research to determine an optimal air pressure of 25 psi for needle-free injection. An additional 15 strip loins were inoculated with generic *E. coli* at a target level of  $10^{5-6}$  CFU/cm<sup>2</sup>. After 1 hour of microbial attachment, matching halves were allocated to needle-free or needle injection with a phosphate and salt solution. Immediately after injection, two cores were taken aseptically from each half and cross-sectional slices were taken at the inoculated surface and at depths of 0.4, 1.2, and 2 in. to determine translocation of generic *E. coli*. Two steaks were displayed 5 days for retail color life evaluation, and a third steak was cooked for slice shear force determination.

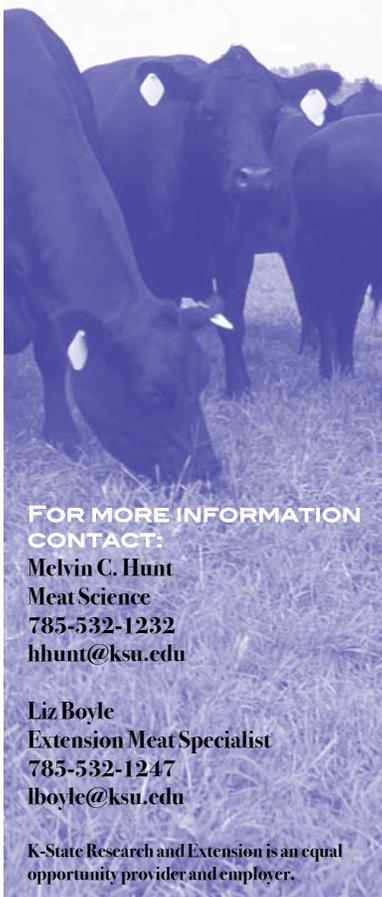
**Results:** Samples taken from the surface of needle-injected muscles had lower ( $P < 0.05$ ) microbial counts than needle-free injected muscles (2.79 vs. 3.23 log CFU/g, respectively). Also, the 1.2- and 2.0-in. depth samples from needle injection had the least ( $P < 0.05$ ) microbial contamination (1.69 and 2.12 log CFU/g, respectively). Traditional needle injection resulted in approximately 0.5 log CFU/g less microbial contamination at all depths. Both treatments resulted in acceptable tenderness; however, needle-free injection improved ( $P < 0.05$ ) tenderness more than needle injection. Needle injection posed fewer microbial risks but resulted in less tender steaks compared with needle-free injection.

**The Bottom Line:** Needle-free injection enhancement might be expected to slightly increase microbial translocation into the muscle interior by as much as 0.5 log<sub>10</sub> CFU/g compared with needle injection but improve tenderness compared with needle controls and have no effect on color display life.

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## Near-Infrared Tissue Oximetry of Beef Longissimus Muscle for the Improvement of Meat Color and Meat Color Stability

*Anand Mohan*

**Objective:** Determine (1) amounts of deoxymyoglobin (DMb), oxymyoglobin (OMb), and total myoglobin (TMb) in beef muscle stored in several packaging formats and (2) tissue oximeter responses to post-rigor muscle fiber orientation and surface measures of color.

**Study Description:** Longissimus lumborum muscles from beef loins (USDA Select, A-maturity, n = 3) were fabricated at 10 days postmortem into twelve 2-in.-thick portions with the fibers either perpendicular or parallel to a designated muscle surface. The thicker portions were necessary to assure that near-infrared (NIR) light did not escape from the tissue. Muscle portions were placed in four packaging treatments: vacuum (VP), polyvinyl overwrap (PVC), 80% O<sub>2</sub>/20% CO<sub>2</sub> (HiOx), and HiOx to PVC. These packages were used to create different partial pressures of gases, altering the muscle chemistry and resulting in different forms of myoglobin. Instrumental color was measured on days 0, 2, 4, 10, and 15 to express changes in meat color data. An NIR tissue oximeter was used on days 0, 2, 4, 10, and 15 to calculate concentrations of TMb, OMb, and DMb for following changes in redox dynamics of myoglobin with advancement of postmortem storage and display time. Values for L\* (lightness), a\* (redness), and b\* (yellowness) were used to calculate hue angle and chroma for discoloration during display.

**Results:** Fiber orientation and storage day affected (P<0.05) TMb, OMb, and DMb in all packaging formats. Portions cut perpendicular to muscle fiber generally had more OMb and greater color stability than portions cut parallel, and as storage time increased, OMb decreased. Packaging format did not affect TMb, but OMb increased and DMb decreased as exposure to oxygen increased.

Tissue oximeter measurements have potential for real-time monitoring of myoglobin redox forms and oxygen status of meat in a variety of packaging formats. To obtain repeatable NIR tissue oximetry measurements on post-rigor muscle, fiber orientation, tissue oxygen exposure, and storage time must be controlled.

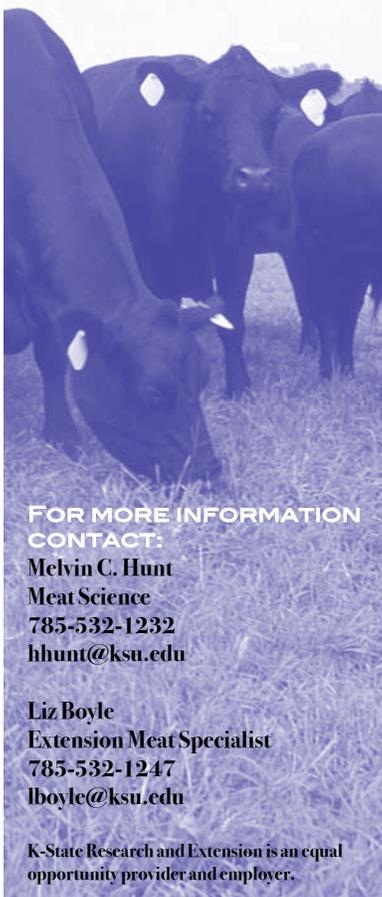
**The Bottom Line:** If the scope of NIR tissue oximetry can be modified slightly for meat, this technology would offer the beef industry the first rapid, real-time, noninvasive instrument for assessing various meat color traits that could help classify product on the basis of color stability differences between muscles.

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## Spotlight on Dry Aging of Beef: Effects of Loin Types, Aging Methods, and Aging Times

*Staci DeGeer*

**Objective:** Determine effects of two dry-aging methods, two cut styles, and two aging times on palatability traits, development of the unique dry-age flavor, weight losses and post-dry aging storage traits.

**Study Description:** Certified Angus Beef shell and strip loin pairs were obtained from a commercial facility; each pair was cut into four sections. Each section was assigned randomly to be aged for 21 or 28 days either unpackaged or in a bag with high moisture permeability. As expected, weight losses increased with aging time. This was the only significant difference between aging for 21 vs. 28 days. Both shell loins and dry aging in a bag reduced weight losses. Sensory traits were excellent for all treatments, and there were no practical differences in any sensory traits between shell and strip loins or between dry aging methods.

### Results:

- Dry aging in a bag produced dry-aged flavor equal to traditional (unpackaged) dry aging.
- Bone-in shell loins yielded more dry-aged product than boneless strip loins.
- Microbial growth was not significantly different in bag dry aging vs. traditional dry aging.
- Product dry aged for 21 days had the same flavor profile but less weight loss than product dry aged for 28 days.
- Dry-aged product can be vacuum stored post-dry aging without major loss in palatability.

**The Bottom Line:** Boneless strip loins aged in a bag that is highly permeable to moisture vapor will have significantly reduced weight loss but similar sensory properties compared with product dry aged traditionally.

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## Thermal Process with Additional Drying Provides Proper Lethality for Controlling Pathogens During Jerky Production

Kelly J. K. Getty

**Objective:** Determine effects of a worst-case scenario thermal processing schedule on reducing *Escherichia coli* O157:H7 and *Salmonella* spp. in chopped and formed beef jerky.

**Study Description:** To validate a worst-case scenario commercial thermal processing schedule, a mixture of *E. coli* O157:H7 and *Salmonella* spp. was added to raw beef batters. Jerky strips were extruded onto screens and dried in a smokehouse. Jerky strips were sampled throughout processing, and reductions of *E. coli* O157:H7 or *Salmonella* spp. populations were determined. Water activity and fat, moisture, and protein content were also measured.

Means and standard errors of *Escherichia coli* O157:H7 and *Salmonella* spp. populations at seven sampling times during production of chopped and formed beef jerky

Stage <sup>1</sup> /sampling time	Pathogen population (log CFU/g)			
	<i>E. coli</i> O157:H7		<i>Salmonella</i> spp.	
	Mean	Standard error	Mean	Standard error
Raw	6.2 <sup>a</sup>	0.07	5.8 <sup>b</sup>	0.08
Stage 2 <sup>2</sup>	4.8 <sup>b</sup>	0.21	2.4 <sup>c</sup>	0.36
Stage 3 <sup>2</sup>	3.7 <sup>bc</sup>	0.08	0.7 <sup>d</sup>	0.23
Stage 4 <sup>2</sup>	3.2 <sup>cd</sup>	0.50	0 <sup>4e</sup>	0.00
Stage 5 <sup>3</sup>	2.1 <sup>de</sup>	0.95	0 <sup>4e</sup>	0.00
Stage 6 (30 min in) <sup>3</sup>	0.9 <sup>e</sup>	0.44	0 <sup>4e</sup>	0.00
Stage 6 (60 min in) <sup>3</sup>	1.4 <sup>e</sup>	0.26	0 <sup>4e</sup>	0.00

<sup>1</sup> Times and dry bulb smokehouse temperatures for thermal stages: Stage 2 – 45 min at 125 °F and 60 min at 130 °F, Stage 3 – 45 min at 125 °F and 60 min at 130 °F and 45 min at 135 °F, Stage 4 – 45 min at 125 °F and 60 min at 130 °F and 45 min at 135 °F and 45 min at 140 °F, Stage 5 – 45 min at 125 °F and 60 min at 130 °F and 45 min at 135 °F and 45 min at 140 °F and 90 min at 145 °F, Stage 6 – 45 min at 125 °F and 60 min at 130 °F and 45 min at 135 °F and 45 min at 140 °F and 90 min at 145 °F and 120 min at 170 °F.

<sup>2</sup> Commercial thermal process.

<sup>3</sup> Additional drying step.

<sup>4</sup> Denotes no *Salmonella* survived the process.

<sup>a,b,c,d,e</sup> Within a column, means without a common superscript letter differ (P<0.05).

**The Bottom Line:** A worst-case scenario thermal process with an additional drying step for producing chopped and formed jerky provided proper lethality to control *E. coli* O157:H7 and *Salmonella* and provides a process that will produce safe jerky for consumers.

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